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CHARTING THE STORM

DMA's ROLE IN OPERATION DESERT SHIELD & DESERT STORM

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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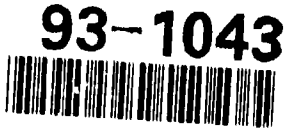

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The increasing importance of geographic intelligence to the Joint Force Commander is illustrated by the cartographic support of the Defense Mapping Agency during Operations Desert Shield and Desert Storm. This paper was done to illustrate the impact that the availability or non-availability of cartographic support plays in modern military operations. The scope of this paper was limited to DMA's aeronautical, topographic, and hydrographic support, which directly influenced the course of both operations. The increased dependency on these products was directly related to the increased sophistication of modern weapon systems. This was further compounded by the non-traditional requirement areas in the post U.S.S.R. world. To future Joint Force Commanders, these products can serve either as a force multiplier, or as an operational constraint -- depending upon their availability.

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The increasing importance of geographic intelligence to the Joint Force Commander is illustrated by the cartographic support of the Defense Mapping Agency during Operations Desert Shield and Desert Storm. This paper was done to illustrate the impact that the availability or non-availability of cartographic support plays in modern military operations. The scope of this paper was limited to DMA's aeronautical, topographic, and hydrographic support, which directly influenced the course of both operations. The increased dependency on these products was directly related to the increased sophistication of modern weapons systems. This was further compounded by the non-traditional requirement areas in the post U.S.S.R. world. To future Joint Force Commanders, these products can serve either as a force multiplier, or as an operational constraint -- depending upon their availability.

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CHAPTER I

INTRODUCTION

The Duke of Wellington is quoted as saying "[I] spent half of my military career wondering what was on the other side of the hill".[1] Though the comment no doubt pertained to all facets of military intelligence, it's literal translation is equally valid. By this I mean the value of knowing the surrounding terrain (i.e., the hill). It is this universal need to know the geography and topography of a region which drives the commander's need for cartographic support. What has changed since Wellington's era, is the scope this intelligence has taken on in modern military operations. With the prospect for operations to be conducted on a global scale, against a proliferation of potential enemies, Wellington's hill has become a continent, an ocean or even a desert. His smooth bore artillery and horse mounted Calvary have become precision guided weapons capable of pin-point accuracy, and airborne divisions capable of world-wide deployment.

Geographic intelligence and the cartographic products derived from it play an increasingly important role in modern U.S. military operations. The environmental and physical information derived from this intelligence source are processed into Mapping, Charting and Geodesy (MC&G) products. This increased reliance on advanced cartographic products is directly related to the growth of high-tech weapons and the global scope of future regional conflicts. With the fall of the U.S.S.R., and the new regional focus, Joint Force Commanders must be prepared to conduct operations in non-traditional areas.

Central to the exploitation of geographic intelligence is the Defense Mapping Agency (DMA). Established in 1972 to consolidate the various mapping organizations in each of the Military Departments, DMA is now the primary source of geographic data for operational military commands. In 1986 the Goldwater-Nichols Defense Reorganization Act designated DMA as a Combat Support Agency.[2] This was in part due to the cartographic shortfalls experienced in Operation Urgent Fury -- the invasion of Grenada. DMA products directly impact the operational effectiveness of all Joint Force Commanders (JFC). No military operations better exemplified the combat support role of DMA than DESERT SHIELD and DESERT STORM. Used in conjunction with other military assets, DMA cartographic products greatly enhanced the Joint Force Commanders' effectiveness.

This paper will discuss how geographic intelligence has been transformed from the rudimentary maps of the Napoleonic commander to the advanced products used by the modern Joint Force Commander. The evolution of geographic intelligence through the use of DMA generated products helped enable the U.S. lead coalition to sucessfully prosecute the Gulf War.

The body of this paper is comprised of three major components. The first defines geographic intelligence and its utility, while subsequntly laying a classic foundation for it's use in military operations. The second uses several examples from Operations Desert Shield and Desert Storm (DS/DS) to illustrate the increasing dependency U.S. military forces have on DMA cartographic support. The third discusses key trends in U.S. military operations and their impact on the Defense Mapping Agency.

CHAPTER II

GEOGRAPHIC INTELLIGENCE vs CARTOGRAPHIC PRODUCTS

Definition. The first question to address is "How does geographic intelligence relate to cartographically produced MC&G products?" The operational commander should view MC&G data as a graphic representation of geographic intelligence. The Defense community considers these intelligence graphics and data sets to be composed of three separate elements: Mapping, Charting and Geodesy (MC&G). The first two components, Mapping and Charting usually refer to a two dimensional graphic representation of a portion of the earth's surface. The difference between the two is that a charting product incorporates data which supports navigation, whereas a map depicts the relative location of features. Geodesy data is either the graphic or mathematical depiction of the physical and gravitational components of the earth. It establishes an accurate foundation on which all subsequent maps and charts are built.

Utility. MC&G data is further identified in groups based on utility. These three applications are aeronautical, topographic, and hydrographic products. Products produced by DMA may contain data from one or more of these elements, at any one of several standardized scales. The choice of

data and scale is directly related to the intended us of the product. For example, an army tank battalion requires a large scale product (i.e., relatively small area, but with greater detail) that shows topographic and cultural features. Whereas an Air Force wing will need smaller scale products (i.e., wider coverage, at the cost of less detail) which show aeronautical features superimposed on a generalized topographic and hydrographic base map.

Classical Foundation. In the lexicon of the modern warrior, MC&G products can play the role of a force multiplier. The ability of terrain knowledge to multiply the effectiveness of a military operation was noted by a contemporary of Wellington, Karl von Clausewitz. In On War, Clausewitz recognized the advantages a commander could gain by knowing the lay of the land in the following quote:

" ...a commander must submit his work to a partner, space, which he can never completely reconnoiter, and which because of the constant movement and change to which he is subject he can never really come to know...and the man with enough talent and experience to overcome it will have a real advantage."[3]

Clausewitz then went on to say that the commander must be able to hold a mental image of the area in order attain a sense of locality.

"A commander in chief, on the other hand, must aim at acquiring an overall knowledge of the configuration of a province, of an entire country. His mind must hold a vivid picture of the road-network, the river-lines and the mountain ranges, without ever losing sight of his immediate surroundings. Of course he can draw general information from reports of all kinds, from maps, books,

and memoirs...with a quick and un-erroring sense of locality his dispositions will be more rapid and assured; he will run less risk of a certain awkwardness in his concepts, and be less dependent on others."[4]

The scale of the modern operational theater makes it extremely difficult for the military commander to grasp Clausewitz's sense of locality. General Schwarzkopf and his USCENTCOM staff were faced with an Area of Interest (AOI) encompassing parts of two continents dissected by numerous bodies of water and countless mountain ranges. The scope of this theater was an exponential increase compared to the provincial campaigns during Clausewitz's time. It was this increase which forced the Schwarzkopf's commanders to rely on external sources to augment their sense of locality. This need was reflected in comments made by LT General Horner when he said:

"After we settled in a period of anxiety began. That's when you [DMA] started getting hit with all these requirements. What it amounted to was we began to look forward to any kind of operations that might occur. We realized that we were in desperate need for things like target materials, mensurated coordinates, products, just nothing more than map, basic charts, and so you started to feel immense pressure back here."[5]

CHAPTER III

DESERT SHIELD/DESERT STORM EXAMPLES

U.S. Joint Force Commanders have become increasingly dependent upon DMA produced products in order to successfully accomplish their missions. The magnitude of DMA's support following Iraq's invasion of Kuwait was reflected in the following statement made by DMA Deputy Director Brigadier General Joesph Pratt:

> "As a combat support agency DMA provided the soldiers, sailors, marines, and airmen with a greater volume and with more accurate maps, charts, digital, and precise positioning materials than in any previous U.S. operation."[6]

General Pratt's quote reflected the volume and accuracy of DMA products during both the Desert Shield and Desert Storm (DS/DS) operations. What this statement failed to reflect was how DMA products allowed the commander to redefine the parameters of modern U.S. operations. This chapter will use a series of DS/DS examples which parallel the earlier utility breakout --aeronautical, topographic, and hydrographic support. In addition, each sub-chapter will be balanced by showing the limitations of DMA support. To the Joint Force Commander, these shortfalls may potentially have severe consequences to his mission.

Aeronautical Charting Support

No single military advancement did more to change the face of military cartography than the advent of aerospace weapons. As the range of aircraft and missiles increased, so did the military's need for geographic intelligence. The multitude of DMA's aeronautical products reflect the expanding need to accurately depict physical and cultural features. To the Joint Force Commander the currency of the source, coupled with its timely decimination, is just as critical as the products' accuracy. Throughout the Gulf War these products impacted every facet of operations from the USTRANSCOM logistican to the LT General Charles A. Horner, the Joint Force Air Component Commander (JFACC).

Logistical Support. DMA's support was not limited to the immediate theater for offensive military actions. DMA's aeronautical charts and databases had already been used by the Military Airlift Command (MAC) to facilitate the airlift of CONUS based units. A facet of DMA support that is not always recognized is their aeronautical specialists. These people were responsible for reviewing hundreds of airfields in support of both Counter Narcotics and Desert Storm; generating an out-of-cycle volume of airfield graphics; plus production of the FLight Information Pamphlets (FLIPs). Coupled with the world-wide coverage of aeronautical charts,

these supplementary products were integral in establishing the airborne logistics pipeline to the operational theater. This same supply line would be used to bring 55 C-5 plane loads of DMA products into the USCENTCOM theater.[7] DMA generated materials, coupled with MC&G support by in theater topographical units such as the Army's Engineering Battalions, helped transform DESERT SHIELD into DESERT STORM.

Air Interdicition. Precision guided munitions used by advanced weapons such as the F-117 and the cruise missile were the hallmark of the Allied air campaign during DESERT STORM. Paramount to the success of these weapons were the technological advancements made by DMA and it's predecessors to precisely identify a point on the earth's surface -- geopcsitioning. DMA's targeting support signifies one of the non-traditional roles that geographic intelligence played in the Gulf War.

During Desert Storm the ability to precisely target enemy positions changed the whole complexion of the air war. This was because U.S. commanders were encumbered by their own military ethos which advocates the use of decisive force; while at the same time minimizing collateral damage. During the Vietnam conflict this paradox lead to a classic "Catch-22" situation where U.S. forces were ordered to take out specific targets, while minimizing civilian causalities. Because of the political sensitivities that this type of collateral

damage can have, President Johnson found himself micromanaging U.S. target selection.

With the advent of precise targeting and delivery systems the U.S. had developed the capability of taking out specific targets in built-up areas, while minimizing Iraqi causalities. During Desert Storm, President Bush allowed General Horner, the freedom to target Iraqi military sites within Baghdad. It would have been interesting to see just how much latitude President Bush would have granted General Horner's Joint Targeting Coordination Board (JTCB) if the U.S. hadn't had the precise targeting capability.

Post-war analysis indicates that this aggressive air campaign caught Saddam Hussein totally off-guard. In short, he failed to appreciate the value PGMs, coupled with the advanced targeting, had on modern combat operations.

The tactical use of PGMs also played a critical role in the strategic execution of the Gulf War*. From the very on-set of Operation Desert Shield to the conclusion of Desert Storm the weakest link was the coalition itself. In large part this was due to the sensitivities surrounding the attack of one Muslim brother, by another. Because of this sensitive issue, it was extremely critical for General Horner to keep

*DMA analysts produce and distribute over 8,000 point positions and nearly 18,000 grided photos to Air Force, Navy, and Marine aviation units. DMA also supported special units at the Pentagon and Defense Intelligence Agency (DIA) with positioning support.[8]

civilian causalities to a minimum. The strategic impact of excessive collateral damage was best illustrated after the bombing of the Command and Control bunker in Baghdad. Even though the targeting was accurate and justified, the large loss of civilian causalities tested the resolve of some of the coalition members. Had civilian causalities been higher the JFACC might have had to modify his air campaign; or in a worse case scenario President Bush might have had to restructure his coalition.

An example of how DMA's real-time support helped change the operational complexion of DESERT STORM was related in the following quote from General Horner:

> "We saw him loading out his Badger bombers at Baghdad with weapons, and so I looked around, and I said, 'What can we put on those?' Some F-16 were taking off in about two hours. We were able to get that flight leader a little happy snap over a digital facsimile machine and coordinates that you [i.e., DMA] could provide us and he was able to take his entire flight away from one target and go to that target. We destroyed seven of those bombers on the ground, and that had to take his heart out of his offensive operations."[9]

Post war analysis showed that DMA's support in this area had been extremely successful. However, there are some limitations to the extent that DMA can support operations of this magnitude. The primary limitation being the Defense Intelligence Agency's (DIA) ability to collate and ship the supplementary materials which make up a complete target package. Subsequent updates were relatively easy for DMA to supply once the basic package was in the theater. The

number of trained analysts and workstations available to support extended operations on the scale of DS/DS was also a limiting factor.

Cruise Missile Support. One of the most vivid images of the Desert Storm air campaign was the video tape showing a cruise missile zipping down a Baghdad boulevard. In it's own way that video demonstrated the role that geographic intelligence can play in modern military operations. Using a variety of DMA produced terrain and target information, these missiles were able to navigate over long distances, at low altitudes, to precisely hit Iraqi targets. DMA's contribution to this system was reflected in comments made by W.C. Bowes, the U.S. Navy's Program Executive Officer for Cruise Missiles when he said: "The significance of your [DMA's] contribution cannot be over stated. Successful cruise missile operations are a culmination of years of DMA effort in developing accurate, reliable Terrain Contour Matching Maps (TERCOM)*, Point Positioning Data Bases (PPDB)** and Digital Terrain Elevation Data (DTED).***"[10]

*TERCOM is a digital data set which contains significant terrain and features used by U.S. cruise missiles. The missile's internal navigation matches these data sets to radar images taken in flight. The missile than corrects its route based on these comparisons/matches. In essence, these data sets are the cruise missile's electronic memories.

**PPDB is one of a family of geopositioning products built by DMA, which support in-theater targeting activities.

With the advent of high-tech weapon systems, such as the cruise missile, the Joint Force Commander must re-examine the impact of geographic intelligence on both the deliberate and operational planning process. In operational terms this support comes down to a question of availability. According to Bowes, USCENTCOM was faced with a limited amount of pre-existing TERCOM data needed to support TLAM operations in early August 1990[11]. It can be deduced from comments such as Bowe's, that the availabilty of TERCOM data sets had a direct bearing on the starting date of the air campaign.

Between the early days of August and the commencement of Desert Storm, DMA was able to greatly expand the employment window of these weapons.[12] This last point can be broken down in terms of good news/bad news for the Joint Force Commander. The bad news is the non-availability of geographic data no doubt limited the JFC's courses of action, during the first phase of Desert Shield. The good news was that DMA was able to respond to this crisis.

The Gulf War is reflective of the type of operations future JFCs are likely to encounter -- regional conflicts in non-traditional areas. In areas such as these, there will likely be a limited amount of pre-existing TERCOM support data, as was the case in DESERT STORM. However, once the

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***DTED is the basic elevation data source used by all military activities and systems that require landform, slope, elevation, and/or roughness in a digital format.[13]

baseline data has been collected by DMA, the Navy and/or the Air Force can quickly collate the data to build a strike package. This last point was reflected in the relatively short amount of time needed to plan the cruise missile attack on the Iraqi nuclear facility on 16-17 January 1993.

MC&G availability, especially in non-traditional areas, will continue to be the most vexing problem for the JFC. The principle problem is that the mechanism used to convey MC&G requests from the commands was not built to meet crisis support situations. Instead, this requirement system was designed to support the more mundane Program Objective Memorandum (POM) cycle. Supporting TERCOM data requests is even more convoluted because it's a composite of several other MC&G datasets. The best way for the JFC to account for these types of shortfalls is to insure that all deliberate planning activities review the presence of MC&G data. To support this, the Joint Operations Planning Exercise System (JOPES) will need to increase the amount of cartographic information within the Time Phased Force Deployment Data system (TPFDD).[14]

From the Joint Force Commanders perspective, targeting support from DMA helped transform the way the U.S. wages war. Nowhere else was this point more clearly made than in the recently released guidance on joint war fighting, A Doctrinal Statement of Selected Joint Operational Concepts. This document states: "National assets such as intelligence

and communication satellites, previously considered principally in a strategic context, have become an important adjunct to tactical operations."[15] Central to this evolving concept of operations is the manner in which precise targeting must synchronize itself with interdiction and maneuver facets of future joint operations. Because each of these are dynamic by nature, the supporting targeting data must be extremely responsive.[16] Precise targeting also qualifies as a force multiplier by reducing the number of missions needed to "kill" a target. Besides freeing up assets for other targets, fewer missions translates into lower casualties to U.S. personnel.

Future Joint Force Commanders may face a potential problem because these systems may be too good. Future operations may evolve to the point where the use of precise targeting systems becomes the accepted norm; thus redefining the use of reasonable force. This could mean that large scale bombing (i.e., carpet bombing) is no longer politically acceptable to the world community, when practiced by the United States.

Topographic Support of the Ground War

Topographic products provided the coalition's Joint Force Commanders (JFC) with the geographic intelligence needed to support ground operations within the Desert Shield and Desert Storm theaters. These products fell into three groups: Topographic Line Maps (TLMs), Digital Topographic Data (DTD); and an interim product called LANDSAT Image Maps (LIMs). Compared to the high-tech geopositional data used to support air interdiction these products, at first, seem relatively basic. However, the only thing basic about these maps were their value to the commanders who had to plan and then execute the ground war. This view was echoed in comments made by an anonymous Army commander who had referred to the potential lack or shortfall of these topographic products as "an absolute war stopper".[17]

Topographic products depict terrain intelligence in either a graphic or digital format. The graphic products are the old standard barer -- the paper map. Whereas the higher-tech product is called Digital Topographic Data (DTD). Unfortunately for the field commanders, both types of products were inadequate for a major contingency in the upper Persian Gulf theater.

"Prior to the invasion of Kuwait, DMA's requirements were for very limited coverage of Kuwait, and frankly oriented towards a different potential war in the Middle East",

according to DMA Deputy Director Brigadier General Joesph Pratt.[18] The result was limited or non-existent coverage in the future deployment areas. Existing products were rapidily becoming obsolescent due to the explosive growth in Kuwait. This growth was spawned by Kuwaiti infrastructural investments related to the petroleum industry. In an ironic twist, the same growth that attracted the Iraqi invasion no doubt hindered the United States' ability to respond to the invasion.

Initial assessments by both DMA and the 30th Engineering Battalion revealed that there were some existing 1:50,000 Topographic Line Maps (TLMS)* of Kuwait and eastern Saudi Arabia, but not complete coverage.[19] The availability or utility of existing Planning Terrain Analysis Data Bases (PTADB) and Tactical Terrain Analysis Data Bases (TTADB) was barely sufficient for force deployment, let alone offensive operations.** This cartographic shortfall triggered three huge mapping efforts by DMA. The first was to design and produce a series of interim graphic products based on

*Cartographic products are identified by their scale. In the case of a 1:50,000 TLM, one inch on the map represents 50,000 "real" inches on the earth's surface (one inch on a 50,000 TLM translates into 1.27 miles on the ground).

**PTADB is a digital database used in theater. It's composed of feature data with an accuracy and data density equivalent to a 1:250K scale chart, with an enhanced transportation file. TTADB is the same except that its accuracy and data density is similar to a 1:50K scale map.[20]

commercial multi-spectral imagery; the second was to initiate the production of 1:50,000 TLMs; and the third was to generate Interim Terrain Data* (ITD).

The interim graphic product consisted of a series of 1:100,000 LANDSAT Image Maps (LIMs). Each of these were composed of cartographic information superimposed on a LANDSAT image. This allowed DMA to quickly build an interim graphic product which was used until more detailed 1:50K and 1:100K TLMs became available. By the end of Desert Storm, this interim product was used to depict geographic data over 102 specific areas within the operational theater.[21]

In spite of the usefulness of 1:50K TLMs, there were still operations which required even finer detail than what is normally depicted on this product. Amphibious assaults, special forces, and the crossing of the Iraqi minefield barrier still required Army and Marine topographic units to supplement DMA products. These field refinements added a higher degree of detail, while also insuring the currency of the intelligence.

The topographic case study also illustrated what happens when the Joint Force Commanders' requests exceed the resources of DMA. When the National Command Authority (NCA) decided

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*ITD is used in several digital ground support systems. It's designed to support operations, intelligence, and logistical planners to visualize terrain, route/site selection, mobility/countermobility planning, communication planning, navigation, and fire support planning and execution.[22] DMA built over 500 ITD cells by April of 1991.[23]

to shift from the defensive posture of Desert Shield, to the offensive planning for Desert Storm it also shifted the MC&G requirements. Unfortunately this voided much of earlier cartographic support done by both DMA and the theater's topographical support units. Because of finite resources, DMA had to suspend ITD production in favor of producing 1:50,000 TLM, which were considered key to the ground operations inside Kuwait and Iraq.[24] To maintain a sense of operational continuity these maps were issued to all coalition members.[25] In order to meet the 15 January 1991 due date, DMA compressed it's normal production time for 1:50K TLMs from six months to six weeks.[26] The due dates for this environmental data --terrain maps, were in part driven by the need to pre-empt another environmental factor --the weather. Maps like these would give Schwarzkoft's commanders the sense of locality needed to plan; and then execute the 100 hour ground war.

Maritime Charting Support

Military and Commercial maritime operations have always been dependent on the accuracy of hydrographic and bathymetric intelligence. During DS/DS the hydrographic and bathymetric products generated by DMA were critical to both military and logistical operations. In regards to the military operations these products played key roles in supporting carrier operations, amphibious assaults, counter-mine, and special operations.

Prior to DESERT SHIELD the U.S. Navy questioned it's ability to conduct extended carrier battle groups operations within the confined waters of both the Persian Gulf and the Red Sea. Driven by military necessity, and aided by the data depicted on DMA marine charts, the Navy was able to deploy these assets much closer to the Kuwait-Iraq theater. These deeper deployments multiplied the effectiveness of carrier based operations, while at the same time expanding the operational range of the Navy's TLAM cruise missiles. This last point shows how the Navy exploitation of DMA's hydrographic charts, complimented the cruise missiles' aeronautical TERCOM data sets.

The value of coastal hydrographic products was first shown during the initial assaults on Tarawa during the Second World War. Coastal hydrographic support also played a major role in the planned Marine amphibious assaults near Kuwait City. Even though the planned assault was overcome by the

rapid advancement of the coalition forces, the operational commanders tasked with the responsibility to plan both the training, and actual assault landings needed a lot of accurate coastal intelligence data. The baseline data was initially supplied by existing DMA Coastal Charts and DMA's new LANDSAT Image Maps (LIMs). These were later supplemented by in-theater topographic units, and covert beach surveys. Even though the combat assault was suspended by General Schwarzkopf, earlier practice landings along the Arabian Peninsula supported the JFC by deception. Because of the media coverage given to these practice assaults, the Iraqi military continued to defend the coastal approaches to Kuwait City. This in turn helped Schwarzkopf pull-off the famous "Hail Mary" thrust into Iraq.

As mentioned earlier, these maritime products were not limited to military applications, but also had logistical applications. When you consider that at least ninety percent of all equipment and supplies which entered the Gulf theater were brought by sea, you can begin to appreciate the critical role of these products. Unlike the military operations the logistical facet of the operation required world-wide maritime coverage.

These same products were also used for non-conventional applications such as when Iraq sabotaged the oil tanker facility. When coupled with multi-spectral imagery, DMA's hydrographic products provided the basis by which the

USCENTCOM staff could monitor and counter Saddam Hussein's first ecological strike. The coastal hydrographic charts were used as a baseline graphic to plot, and then to predict the advance of the oil slick. Besides the environmental impact the oil slick posed a threat to the military operation. because it threaten several Saudi Arabian desalination plants. These plants were important to Schwarzkopf because they helped supply the coalition forces with water.

The Gulf War also demonstrated some limitations that DMA has in regards to it's hydrographic and bathymetric products. These problems were not new to DMA. In fact they had been previously identified as a result of naval operations done in conjunction with EARNEST WILL. Unfortunately, because of limited resources and the nature of the products DMA was still in the process of updating these hydrographic products, when Kuwait was invaded. Complicating this update process was DMA's inability to verify bathymetric data collected in the northern portion of the Persian Gulf. This shortfall was outside of DMA's control since the original updated data set was held in a Kuwaiti library, which was "liberated" by the Iraqis in August.

The future role of hydrographic products, especially those covering coastal areas will continue to play an increasing role in naval operations. This is a reflection of the U.S. Navy's shift towards brown water littoral operations.

CHAPTER IV

CARTOGRAPHIC SHORTFALLS AND LIMITATIONS

It was once said that we learn more from our failures, than from our successes. This statement also rings true for those cartographic lessons learned by DMA during the Gulf War. These lessons also have special relevance to the operational commander who must know the limitations of DMA products and services. Throughout the first part of this paper specific limitations were included in each sub-chapter. This chapter will review those problems which encompass the whole MC&G infrastructure; as opposed to product specific problems. Problems dealing with MC&G source acquisition, insufficient MC&G support staffs, product currency issues, and the continued need for MC&G units to supplement DMA's products will all be addressed in the following sub-chapters.

MC&G Source Limitations. The major limitation to DMA support was the lack of MC&G source material. This source provides DMA with the building blocks to construct MC&G products. Without a higher priority to task the collection of this source material, DMA was unable to support all MC&G requests. During the Gulf War this meant that DMA was unable to provide some Point Position Data Bases (PPDBs) or TLM recompilations.[27]

DMA circumvented some of these short falls by procuring and rectifying LANDSAT data over Kuwait, southern Iraq, and northern Saudi Arabia for the creation of an interim product. Despite some of the benefits associated with multi spectral imagery, there resolution isn't sufficient to meet the accuracy requirements of many of DMA's products.

MC&G Theater Support Broken. MC&G support within the USCENTCOM theater was broken. This problem was a reflection of the limited size of MC&G staffs, coupled with the limited amount of influence DMA has in the requirements process. The result was that DMA was forced to build labor intensive products to meet requirements which could have been satisfied with a less resource intensive product (1:50K vs 1:100K TLMs).[28]

Standardization Problems. Another problem with this system is that there is a proliferation of MC&G dependent systems which aren't standardized. Most of these non-standardized systems are built around digitized data. This point was made by Col David F. Maune when he wrote "Digital imagery from Landsat and SPOT, as well as the Digital Topographic Data (DTD) from DMA, came on 9-track tape; but no Army tactical system used that standard media". Both DMA and the Army's Engineer Topographic Laboratories are working to force all contractors to standardize their systems to except DMA format

as "standard". Every attempt should be made to standardize digital systems to DMA standards; while at the same time retaining the capability to produce high resolution data for small but significant operations.[29]

Coverage & Currency. Current Requirements, Production, Storage and Distribution Procedures did not ensure adequate map support for deploying forces. This statement reflects all the support problems DMA experienced with a large scale contingency plan. The shortfalls identified have the following implications:

- The requirements process and priority system are not as responsive as they need to be in order to meet changing world situations.

- There still exists many areas of the world where DMA does not have sufficient coverage to support contingency operations.

- DMA does not have an efficient method to determine the adequacy of existing maps and charts.

- DMA prints and stores too many copies of maps that are inaccurate, out of date, or are built on the wrong datum.

- DMA does not have a rapid update of these maps for deploying forces.

- The JOPES does not contain sufficient MC&G TPFDD information to ensure that sufficient quantities of maps can be made available at deployed locations.

- DMA doesn't control the inventory, so it cannot ensure that available maps are distributed to the proper forces.[30]

All of these points have one thing in common, that despite the technolgical enhancements made in the field of geographic intelligence and cartography, DMA is still faced with the age old problem of balancing coverage with currency. As shown during the early days of DESERT SHIELD, there are still limits to how much, how detailed, and how often the world could be mapped.

The best way to offset these shortfalls is to use the Army and Marine topographic units to supplement those areas of coverage which DMA can not economically support. In addition to area shortfalls. these units provide the Joint Force Commander with the means to obtain tactical terrain intelligence for critical battlefield areas. During the Gulf War the joint efforts by both the topographic units and DMA were able to overcome the MC&G shortfalls that existed in the early days of DESFRT SHIELD. This is an important point because the Gulf War helped demonstrate the complimentary nature of these two MC&G elements.

Perhaps the biggest lesson was that the world is a big place and that it is dynamic. Starting with DESERT SHIELD and going up to the current PROVIDE COMFORT, two trends are becoming clear. The first is that U.S. military operations will be scattered in non-traditional areas; and the second

is that there will not always be much advanced warning. This poses a problem to the operational commander because DMA's coverage still reflects the priorities established throughout the Cold War (i.e., Central Europe and Korea). This means that in situations such as DESERT SHIELD, DMA will have to move to a crisis support footing, or re-prioritize their current production requirements.

CHAPTER V

CONCLUSION

Since the time of Clausewitz and Wellington the role of geographic intelligence, and the cartographic products which display it, have evolved from a luxury to a necessity. The increasing importance of this geographic intelligence to the Joint Force Commander (JFC) is illustrated by the cartographic support provided by the Defense Mapping Agency (DMA) during Operations Desert Shield and Desert Storm. DMA's aeronautic, topographic, and hydrographic support directly influenced the course of both operations. The increased dependency on these products was directly related to the increased sophistication of modern weapon systems. The Gulf War illustrated how timely support from DMA can support both contingency plans and real-time operations. Two trends are becoming clear. The first is that U.S. military operations will be scattered in non-traditional areas. The second is that there will not always be much advance warning. This poses a problem for the operational commander because DMA's coverage still reflects the priorities established throughout the Cold War.

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